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Agenda item 6.3

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INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (of UNESCO)

WORLD METEOROLOGICAL ORGANIZATION

Sixteenth session of the Data Buoy Co-operation Panel
(Victoria, B.C., Canada, 16-20 October 2000)

REPORT BY CLS/SERVICE ARGOS

This document contains the report by CLS/Service Argos on Argos system functionning during the past intersessional period.

The Panel will be required to take the attached information into account when discussing agenda item 6.3.

REPORT ON 1999-2000 OPERATIONS

1 - SYSTEM OPERATIONAL STATUS

1.1 - Ground receiving stations

1.1.1 - Global receiving stations

During the course of 1999, Fairbanks stopped sending us STIP data sets from NOAA-12 (D). At the same time, Wallops Island only delivered two STIP orbits a day for this satellite.
Consequently, instead of receiving 24 hours of data we now only have three hours, which is not nearly sufficient for the precise orbit determination for NOAA 12 (D), required to supply our users with good location data.

Since NOAA-15 (K)'s frequency was changed, Lannion is no longer able to provide STIP data sets for this satellite.

Figure 1.1.1 shows STIP data set arrival times at the Toulouse and Largo processing centers.

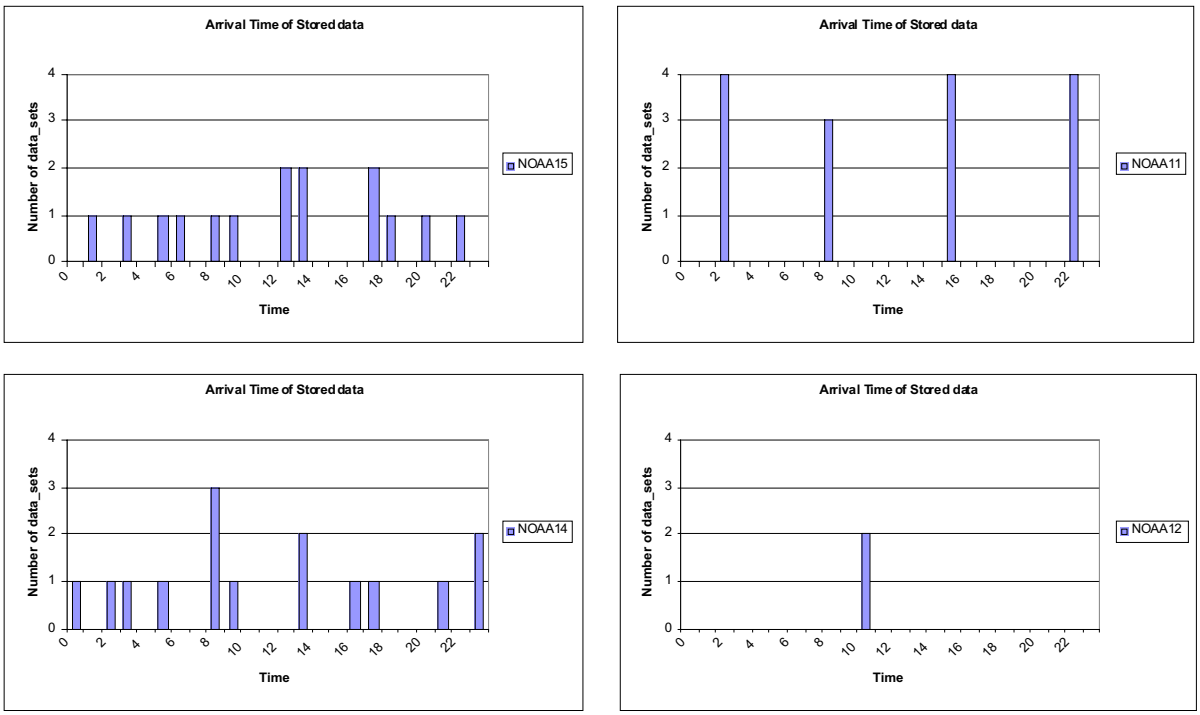


figure 1.1.1.a:

1.1.2 Regional receiving stations

CLS and Service Argos Inc. pursued their efforts in 1999 and 2000 to secure new cooperation agreements with a number of organizations to increase the number of receiving stations able to provide TIP data sets from the NOAA satellites.
Today, 21 stations deliver TIP data sets to CLS and Service Argos Inc. This is an increase of 3 stations from last year.

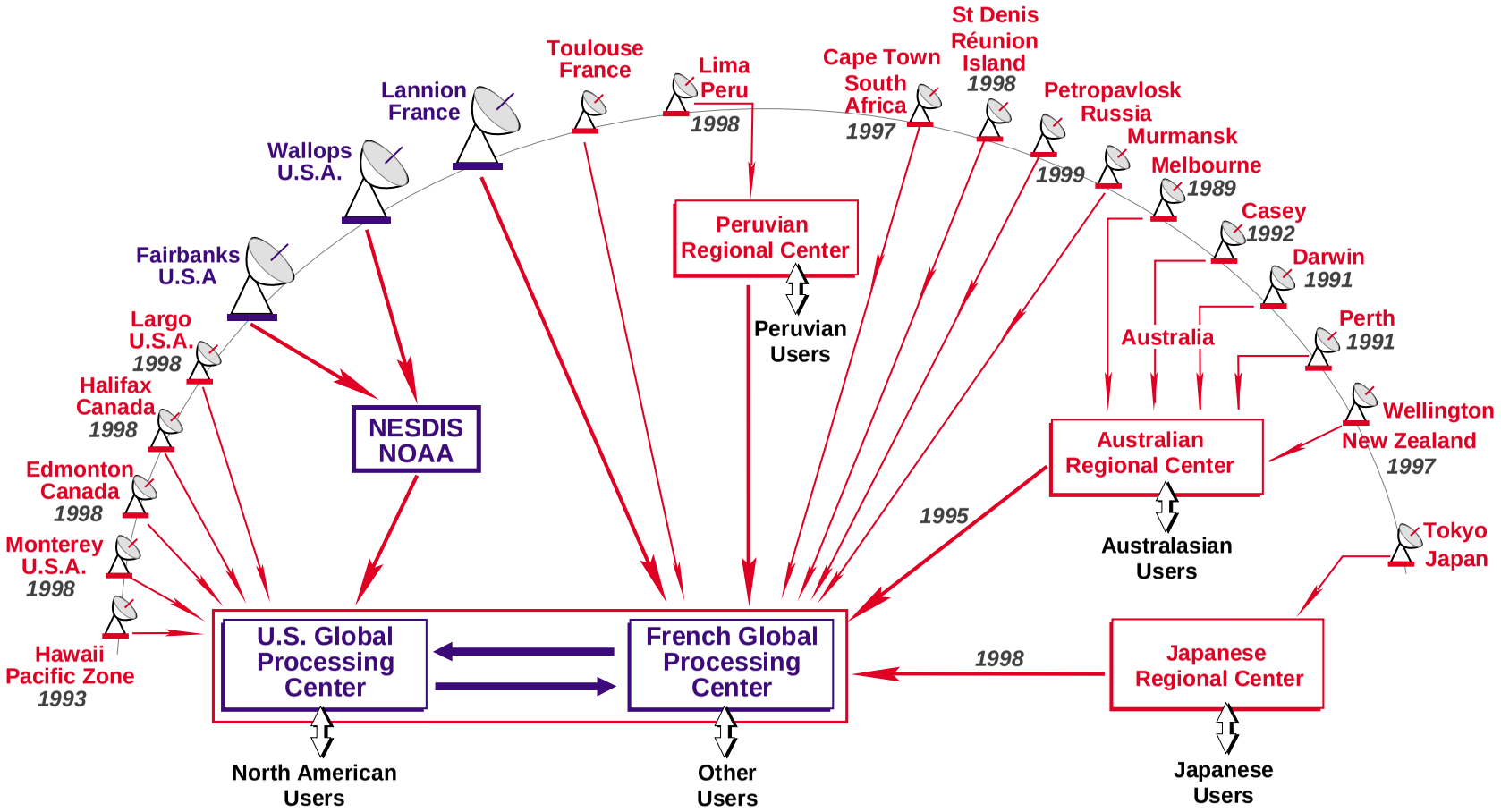
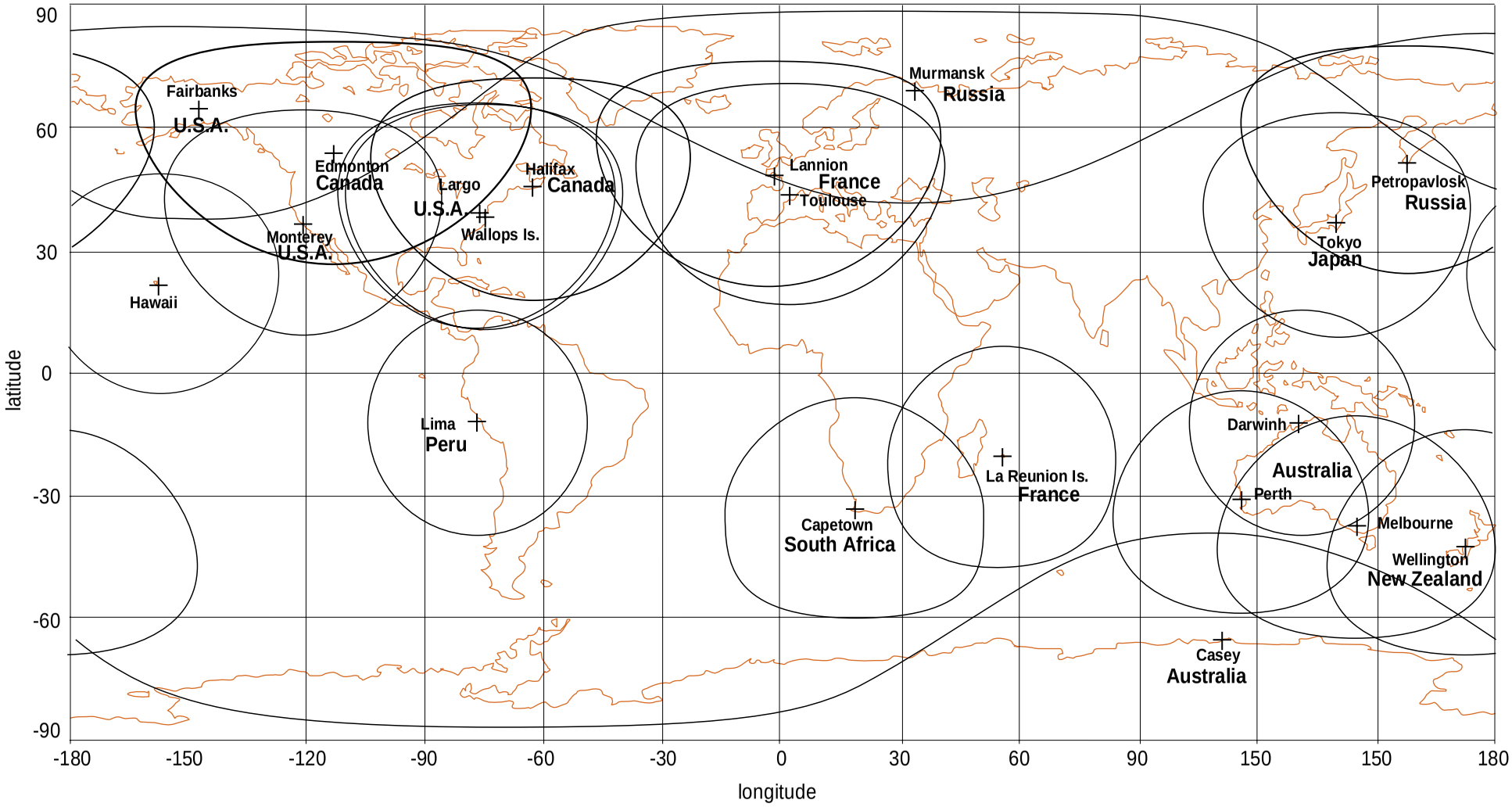


figure 1.1.2.a: Regional receiving station network



1.1.2.b Argos regional coverage

2000 **Regional stations**	**Country**	**Operator**	**Satellites**
Cape Town	South Africa	CLS/SAWB	NK, NJ, ND, NH
Melbourne	Australia	BOM	NK, NJ, ND
Darwin	Australia	BOM	NK, NJ, ND
Perth	Australia	BOM	NK, NJ, ND
Casey	Australia (Antarctica)	BOM	NK, NJ, ND
Lannion	France	Météo France	NK, NJ, ND
Reunion Island	France	Météo France	NK, NJ, ND
Wellington	New Zealand	Met Office	NK, NJ, ND
Gilmore	USA	NOAA	NK, NJ, ND
Wallops	USA	NOAA	NK, NJ, ND
Miami	USA	NOAA	NK, NJ
Toulouse	France	CLS	NK, NJ, ND, NH
Largo	USA	SAI	NK, NJ, ND, NH
Lima	Peru	CLS perù	NK, NJ, ND,NH
Murmansk	Russia	Complex System	NK, NJ, ND,NH
Petropavlosk	Russia	Rybradion	NK, NJ, ND,NH
Tokyo	Japan	Jamstec	NK, NJ, ND, NH
Halifax	Canada	Environment Canada	NJ, ND
Edmonton	Canada	Environment Canada	NJ, ND, NH
Hawaï	USA	National Weather Serv.	NK, NJ, ND
Monterey	USA	National Weather Serv.	NJ, NK

figure 1.1.2.c

Table 1.1.2.c gives the list of regional receiving stations with their location, the organisation responsible for operation and which satellitesare received.
Unfortunately, not all these regional stations receive data sets from all four satellites (NOAA-15, NOAA-14, NOAA-12 and NOAA-11).
For example, many do not receive data from NOAA-11 because the AVHRR instrument is inoperative.
Other stations can no longer receive data from NOAA-15 since the frequency of the HRPT channel was changed.

1.2 Processing centers

1.2.1 General

Each of the five Argos processing centers in Toulouse, Largo, Melbourne, Tokyo, and Lima operated without a major hitch in 1999.

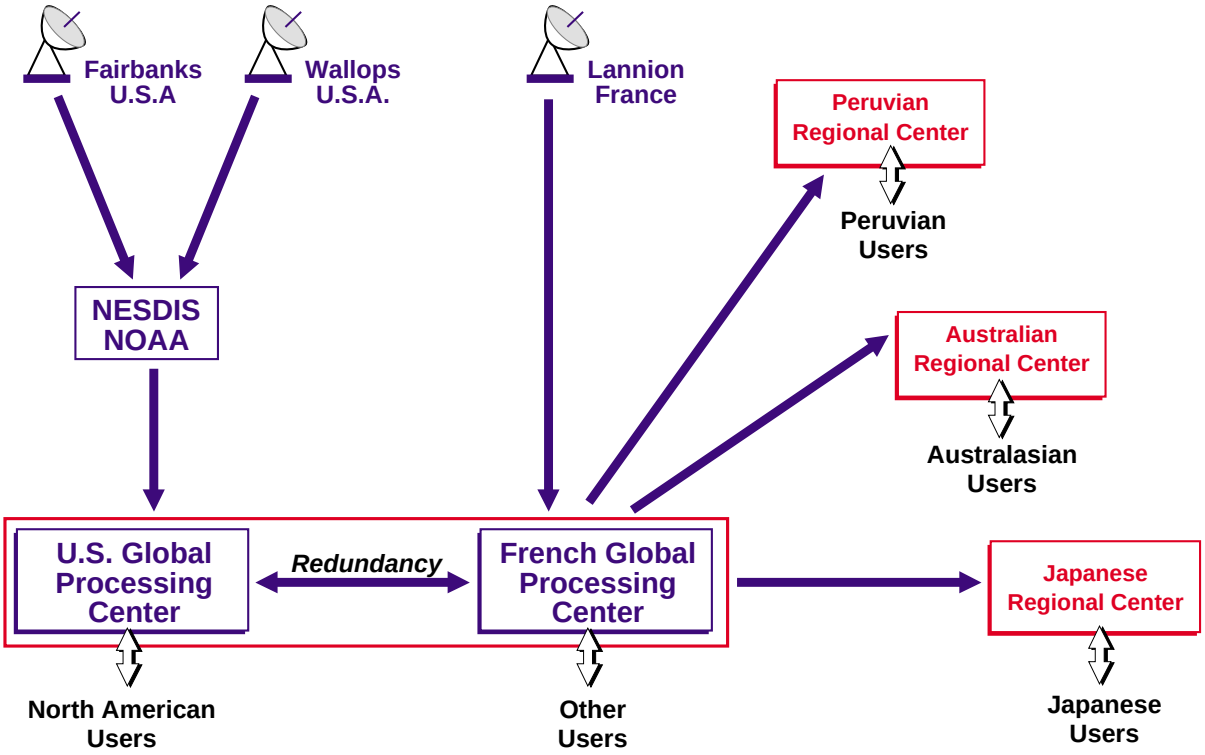


figure 1.2.a: Argos processing facilities NOAA satellite global coverage

1.2.2: Operations

In Toulouse, we have resolved the problems encountered with our backup power supply in 1998. The system is now working perfectly.
The two global processing centers in Toulouse and Largo continue to process data sets from all receiving stations, which is a total of 270 data sets per day

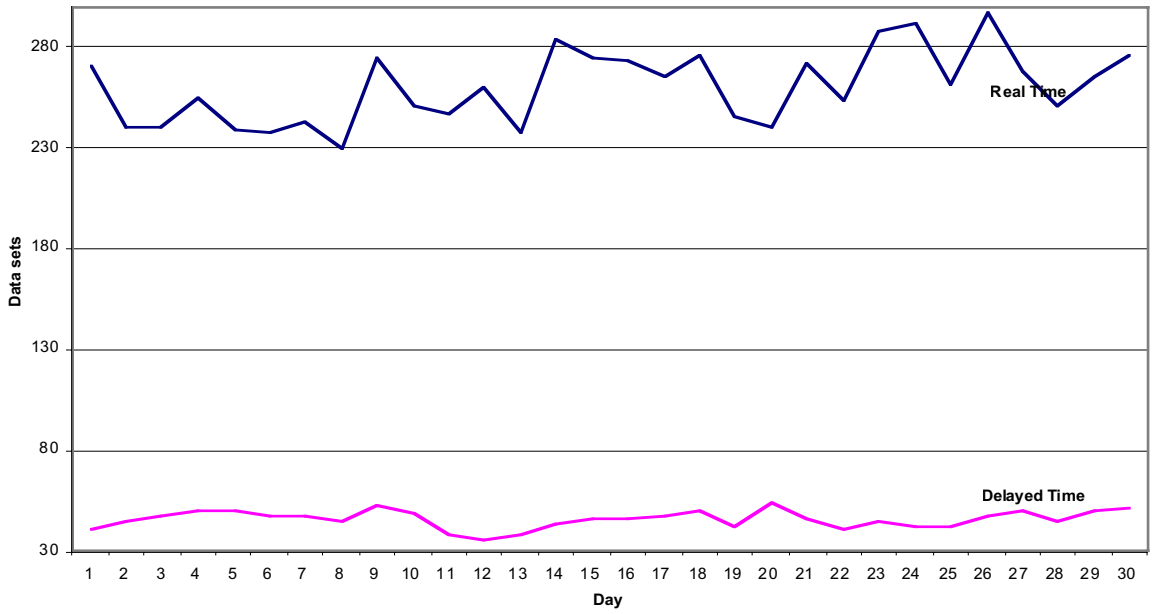


figure 1.2.2.a

Due to the large number of receiving stations and because each station tracks three or four satellites, the global processing centers in Toulouse and Largo are now having to process more and more regional real time data sets (ie data received during the 10-12 minutes of a satellite pass over a receiving station.)

Figure 1.2.2.a shows the number of regional real time data sets and global stored data sets processed every day by the Toulouse and Largo centers.

1..3 Space segment

1.3.1. Operational satellites

NOOA-16 (L) was launched on sept. 20, 2000 and will replace NOAA-14 (J) as one of the two NOAA operational satellites.
NOAA-15 (K) and NOAA-14 (J) have been operating nominally, as primary satellites, since December 1st , 1998 and December 30, 1994, respectively (see table 1.3.2a)

1.3.2. Others Satellites

NOAA 11(H) is the secondary satellite. Its global data is transmitted according to the " third satellite " transmission characteristics
NOAA 12(D) is on " stand by " status, with a nominal Argos equipment operating in direct transmission mode.
NOAA 9 (F) and 10 (G) were decommissioned.

Satellite status	May 98	December 98	October 99		2000
Under Test		15 - NOAA K			
Operational	14 - NOAA J (1) 12 - NOAA D (1)	14 - NOAA J (1) 12 - NOAA D (1)	15 - NOAA K (1) 14 - NOAA J (1)	15 - NOAA K (2) 14 - NOAA J (1)	15 - NOAA K (2) 14 - NOAA J (1)
Back up Third satellite	11 - NOAA H (3) 10 - NOAA G (4)	11 - NOAA H (3) 10 - NOAA G (4)	11 - NOAA H (3) 12 - NOAA D (3) 10 - NOAA G (4)	11 - NOAA H (3) 12 - NOAA D (4)	11 - NOAA H (3) 12 - NOAA D (4)
Decommissioned	*table 1.3.2.a* 9 - NOAA F	9 - NOAA F	9 - NOAA F	9 - NOAA F	9 - NOAA F 10 - NOAA G

1) global data collected with 3 global stations
2) global data collected with 2 global stations (Lannion inoperative)
3) global data transmitted daily when possible - Global delays: 4 to 8 hours

4) regional data collection - regional orbitography
no data available

1.4 System performances

1.4.1 Throughput time for delivery of results

CLS throughput times for delivery of results are calculated in terms of the time taken to reach end users.
For each message received by the satellite, we compute the time elapsed between the recording of the message on board the satellite and the delivery of the results to the end user.
Table 1.4.1.a shows throughput time for delivery of results for stored data from NOAA-14 and NOAA-15, the two operational satellites.

	NOAA 14 - 15	NOAA 11-12
1 H	17%	3%
2 H	37%	15%
3 H	64%	30%
4 H	85%	55%
5 H	92%	70%
> 5 H	100%	100%

Table 1.4.1.a: Stored data throughput time

37 % of the data are available within two hours while 64 % of the data are available within three hours.

Only 30 % of the data are available within three hours from NOAA-11 and NOAA-12
as opposed to 64 % for the two operational satellites. This delay is due to the data set delivery times.

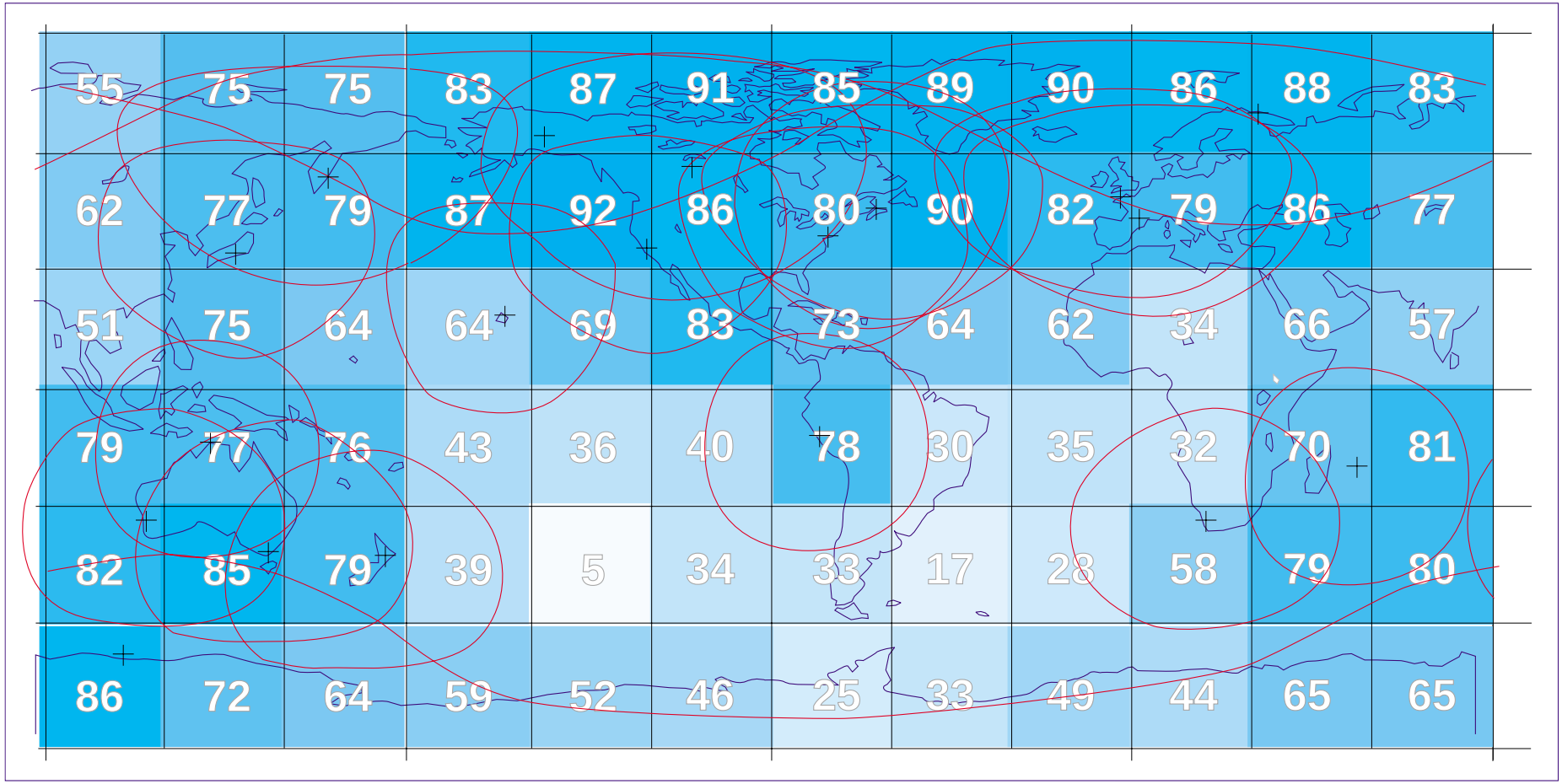
Figure 1.4.1.b shows the throughput time for delivery of results for real-time data from NOAA-15, NOAA-14, NOAA-12 and NOAA-11 and acquired by the 21 HRPT receiving stations.
85 % of these real-time data are available within 30 minutes.

	NOAA 14 - 15 NOAA 11-12
10mn	3%
15 mn	21%
20 mn	43%
30 mn	85%
45 mn	97%
60 mn	99%
> 60 mn	100%

figure 1.4.1.b: Real time data throughput time

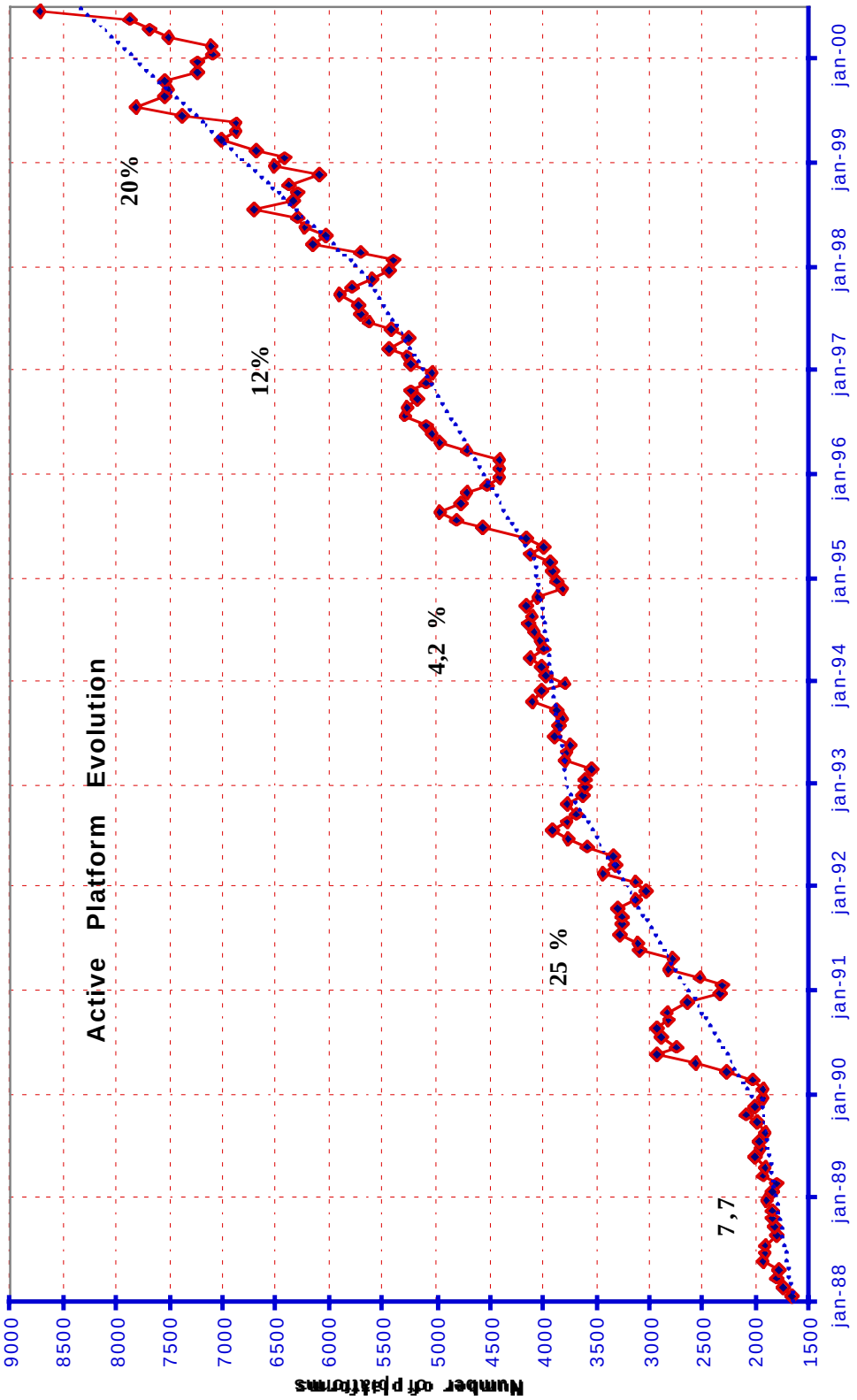
The throughput time for delivery of results for real-time data includes three main delays:
- the satellite pass duration, because we have to wait for the end of the pass to transfer and process the data set;
- the time taken to transfer the data set to the global processing centers. Most transfers go over the Internet. The transfer rate is getting better and better.
- The time taken to process the data set by the global processing centers, which is not significant (less than 30 seconds).

Percentage of real time data received in each geographical square (june 2000)



Active platform number evolution since 1988

An active platform is a platform seen at least once per month by the Argos system.



SYSTEM IMPROVEMENTS

1 - HARDWARE CONFIGURATION

Two new HRPT stations joined our network of ground receiving stations in 1999, in Murmansk and Petropavlosk, Russia. They are helping to improve Argos data throughput times.
The station in Hawaii, operated by the University of Hawaii, was replaced by the National Weather Service's receiving station.
The Monterey station, previously operated by the US Navy, was also replaced by the National Weather Service station.
Other projects are underway and we hope they will come to fruition this year. For example, we are discussing data reception agreements with Miami, Cayenne, and Singapore.

2.SOFTWARE CONFIGURATION

A great deal of work was done in 1999 to ready our software for the Y2K transition. This task involved checking over two million lines of code.
Two new services were added to enhance ADS data distribution:
- automatic transmission of data from a platform as soon as it enters a specified zone, and
-secure data transmission via a PGP protocol.
In addition to these software activities, work continued on two major projects to improve Argos system performance: Argos 2001 and Argos/Next.

3 - PROJECTS

3.1 Argos 2001

The purpose of the Argos 2001 project is to upgrade the entire Argos processing system. This ambitious project is vital for the long-term continuity of the Argos system and to better serve users.
This project is scheduled in three phases:

Phase I: development and implementation of a new user interface allowing users to access data and view and update technical files via a Web server. The System Use Agreements database will also be implemented during this phase. Data will be stored and managed by a database management system designed to be responsive to users' needs. Our objective is to give users more versatility in using the systemS. Consequently, we will be expected to offer them quick and efficient support.

Phase II: Improvement and development of value-added services.
Phase III: Redesign of the Argos processing system.

Current status:
Phase I began at the end of 1998 and is underway.
The user management application is operational.
Development of the User Office application has been completed and rollout is scheduled for the end of 2000.
The Web user interface is in development and rollout is also scheduled for the end of this year.

3.2: Argos/Next project

The downlink messaging capabilities provided by the ADEOS II/Argos DCS equipment requires the addition of two new components to the current Argos ground segment:

A Downlink Message Management Center (DMMC)
located at CLS premises in Toulouse, France.
The DMMC's role is to centralize, validate, and schedule downlink message requests from users before transmitting downlink messages to the satellite (via a Master Beacon).

The Argos Web server developed within the scope of the Argos 2001 project will allow users to:
- enter requests and compile downlink messages for platforms carrying an Argos Next/Argos 3 receiver;
- monitor request status until completion.Note: a backup DMMC will be installed at

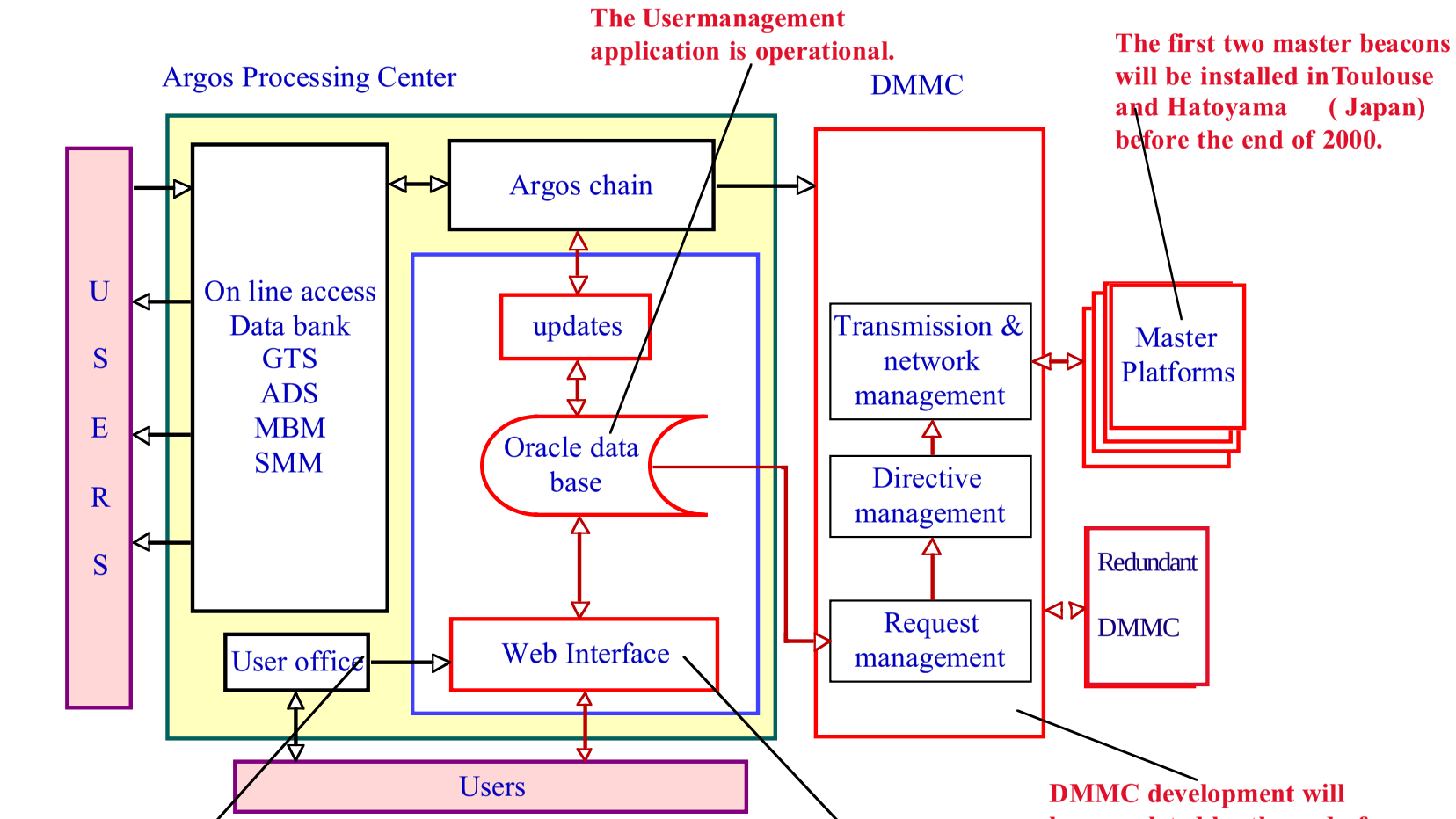


Figure 3: Argos 2001 and Argos Next projects

SAI Largo (USA).
DMMC development will be completed by the end of 2000.

A network of four master beacons,
located at strategic points around the globe, acting as the link between satellites and the DMMC.
The four locations foreseen for these beacons are:
Toulouse, Hatoyama, Fairbanks, and Spitsberg (TBC).

Development of the prototype is complete. The first two master beacons will be installed in Toulouse and Hatoyama (Japan) before the end of 2000.

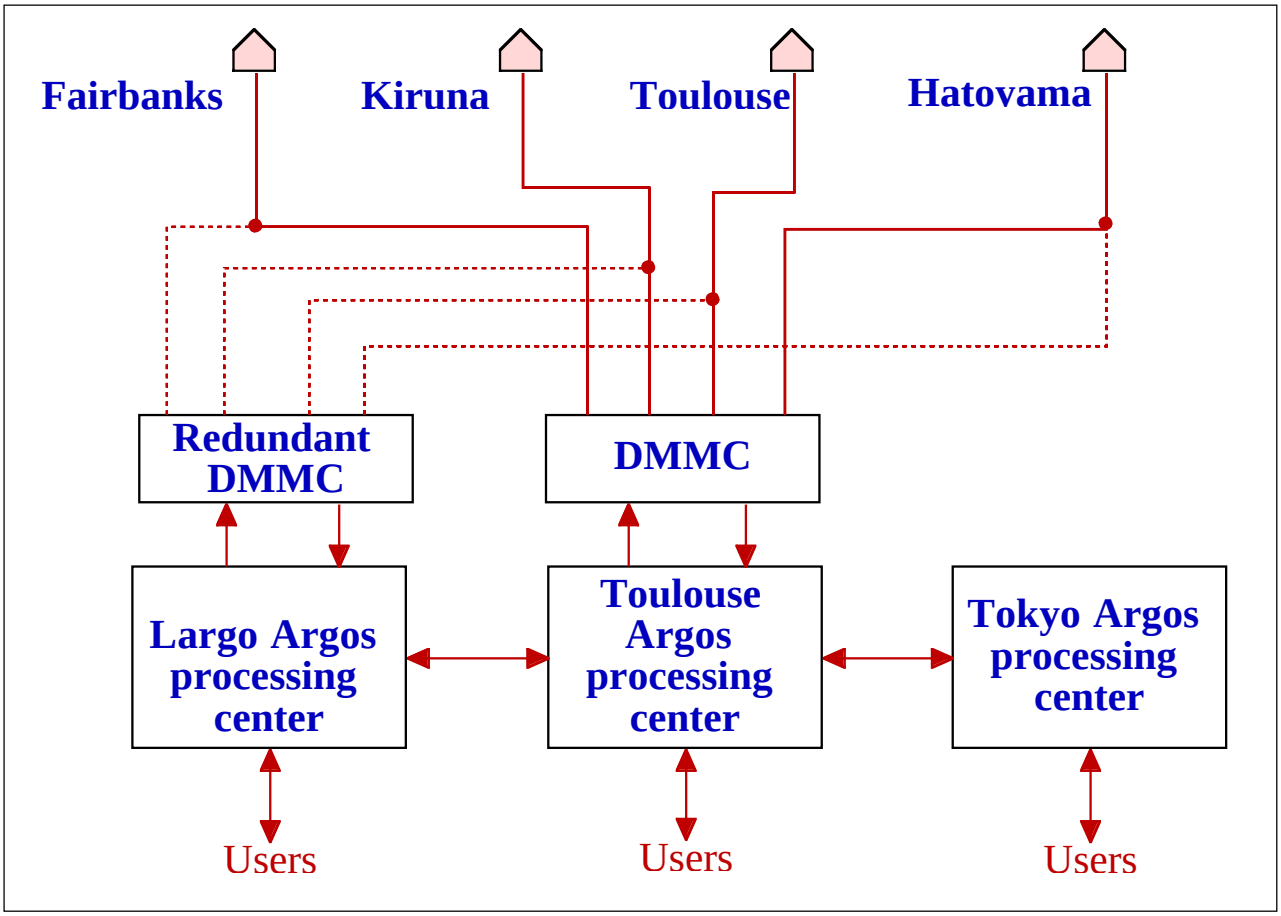
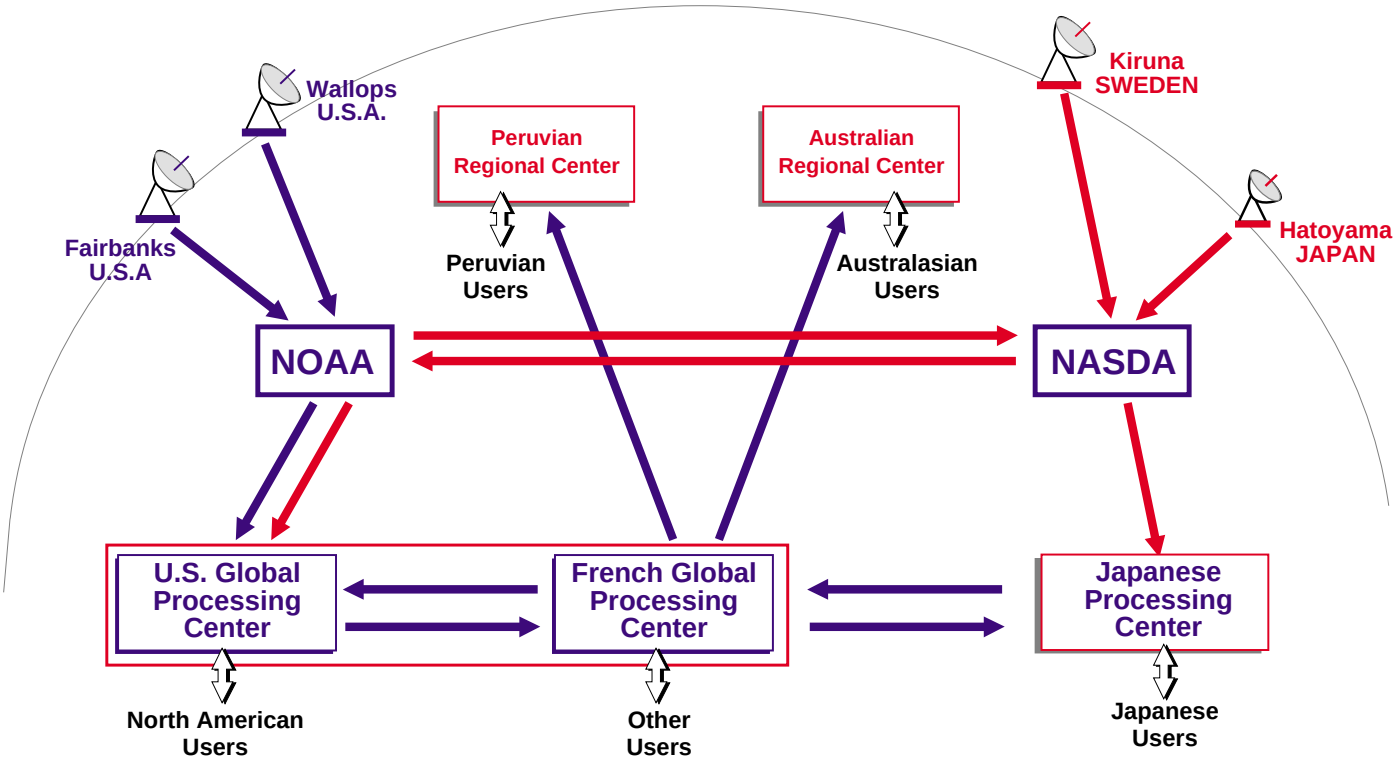


figure 3.2.a: Masterplatforms and Downlink Messaging Management Center

This project is also managing the current Argos software upgrade to support:

- file exchanges with the ADEOS II ground segment;
- ADEOS II spacecraft maneuvers in computing the User platforms locations;
- ADEOS II/Argos DCS Level-0 data and Housekeeping telemetry processing;
- processing of Argos messages related to the downlink messaging service;
- 28-bit ID numbers.

All these modifications have now been completed. The launch of ADEOS-II, previously scheduled for November 2000, has now been pushed back to November 2001.



4. FREQUENCY SPREADING

Action Item N° 32-2-C from the Operation Committee (june 1998)

The Argos Operations Committee, recognizing the need to optimize the use of the frequency bandwidth, currently allocated to the Argos System 401.650 MHZ +/- 12 KHz, resolves:

1) that the central frequency to be used by future Argos Data Collection Platforms be 401.650 MHZ, 401.648 MHZ and 401.652 MHZ. All three frequencies being equally used,

2) that CLS shall take the necessary measures for manufacturers to develop corresponding Argos DCPs,

3) that CLS should undertake the necessary studies to further optimize the utilization of the band allocated to the Argos System.

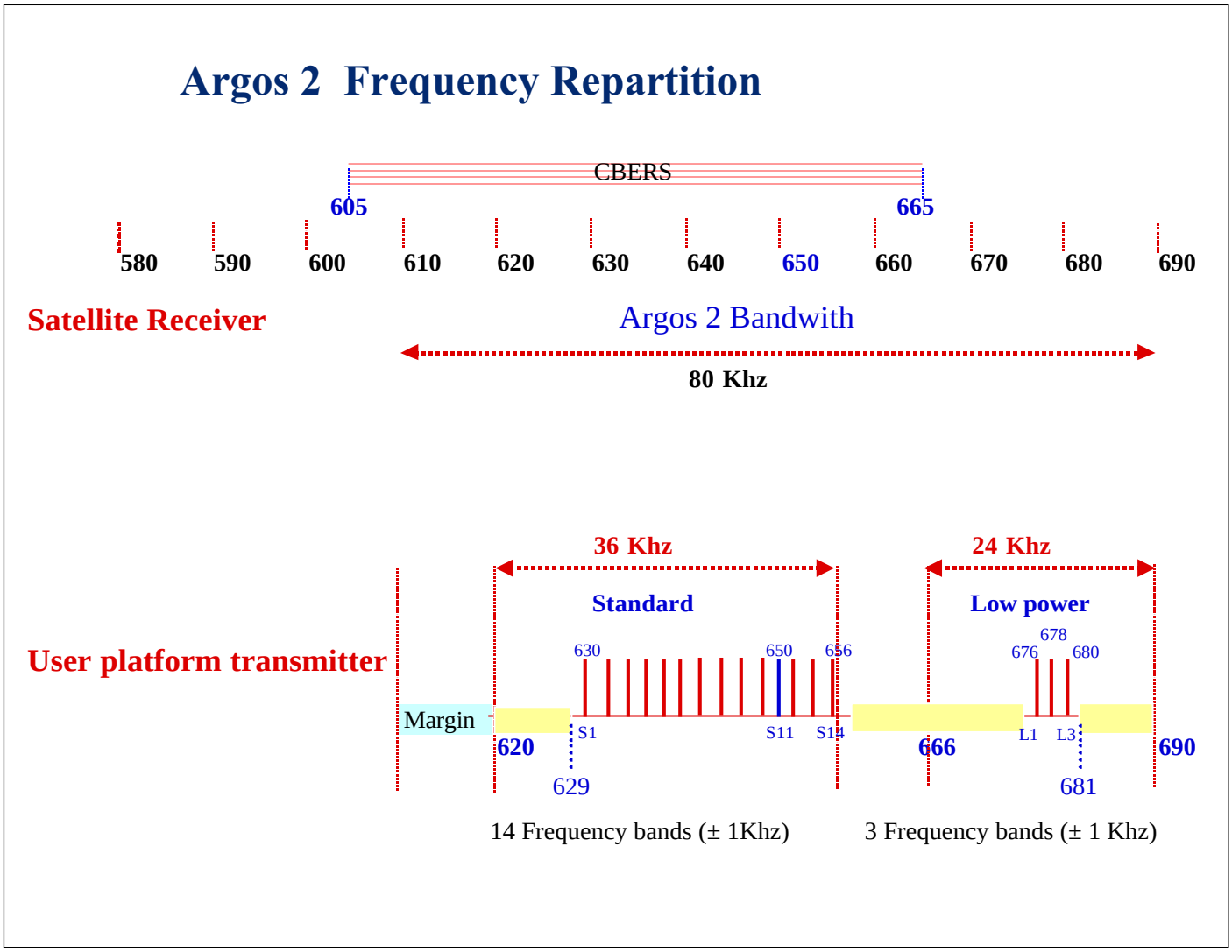
Transmitted frequency distribution

Taking advantage of the wider bandwith available with Argos 2 (80 KHz), a PTT transmitted frequency can now be set inside the Argos bandwidth between 401.629 MHz and 401.681 MHz.
In that bandwidth, we define 17 channels. Each channel is 2 kHz width.

According to the transmitter power, the transmitted frequency shall be set to:

- Channels S1 to S14 for transmitters which transmitted power is less than 3W but more than 500mW;
- Channels L1 to L3 for transmitters which transmitted power is less than 500mW.

Name of the Channel	Center Frequency MHz
S1	401.630
S2	401.632
S3	401.634
S4	401.636
S5	401.638
S6	401.640
S7	401.642
S8	401.644
S9	401.646
S10	401.648
S11	401.650
S12	401.652
S13	401.654
S14	401.656
L1	401.676
L2	401.678
L3	401.680



Periodic monitoring

1) CLS periodically monitors all PTT's in the system and the frequencies used by each one. The results show that a majority of PTTs are still using a frequency of ± 1 kHz with respect to the central frequency of 401,650 kHz.
However, following CLS action the percentage of platforms using this bandwith has been decreasing:

88% in 1997
78% in 1998
67% in 1999
58% in 2000

Unfortunatly during the four last years the total number of active platforms increased by 94 %. The result in still divergent.

Actions

CLS sent a letter to each transmitter manufacturer requesting that they take the necessary steps to move away from the central frequency at least as far as ±2 kHz.
This letter was followed by visits in May 1998 and April 2000 to each of the major manufacturers (those representing a significant share of production). The purpose of these visits was to pursue a dialog with them, collect first reactions and encourage a response to the letter.A general meeting was also convened in September 99.

> Meeting summary on the spreading of transmitter frequencies across the available bandwidth:
>
> The need for spreading the Argos transmit frequencies across the available is based on the fact that the majority of transmitters in service today are operating at the central ARGOS frequency of 401.650MHz, and that spreading the transmit frequencies across the bandwidth will enable a higher the number of messages to be received.
>
> There was general agreement among the participants that the concept of frequency spreading is acceptable. It was also felt that this would very likely have some impact on the cost of building a transmitter.
> The timing of the spreading will be in phases that are not yet defined, although manufacturers are strongly encouraged to begin using frequencies S10 and S12 (which are +/- 2 kHz about the center frequency of 401.65 MHz) immediately then eventually spread frequencies across the entire available band.
> The timing of the frequency spreading over the Argos-2 bandwidth will most likely be applications dependent and will be driven by, among other things, **the launch of NOAA L** and the total number of satellites that are available for use.
> For low power applications it is expected that using only three frequency channels (401.676, 401.678 and 401.680 MHz) will be adequate for the mid-term future since these applications typically have long duty cycles.
>
> The overall process of frequency spreading will be implemented cooperatively between Argos and the manufacturers. Progress will be monitored.

3) Next step should be to take decisions to accelerate the frequency spreading process after the launch of NOAA L.

5: REVIEW OF USER'S REQUIREMENTS

Data Buoy Cooperation Panel (1999)

5.1 The chairman of the DBCP reported on the main conclusions of the fifteenth session of the panel (including the technical workshop), Wellington, 26-29 October 1999, which were of interest to the JTA.

5.2 The following specific recommendations were made by the panel session to the JTA:

(i) There is a need to improve data reception and dissemination within the International South Atlantic Buoy Programme (ISABP), which could be effected through the establishment of connections between existing S-band stations potentially available to support the programme and the Argos processing centres. CLS should undertake this work as part of the Argos development programme;

Action:

Three LUTs are in operation in South-Atlantic:

- Two LUTs provided by Navoceano are installed on Marion and Gough Islands. They are operated by SAWB. Datasets are relayed to SAWB in Cape Town. Navoceano sent Y2K updated equipment early this year and the stations are operating properly locally. There are still some communication problems to be resolved before getting the data to Argos centers.
- A LUT has been installed in Falklands but there are no lines connecting it (yet) to the Falklands-UK data (internet) link.

Item open.

(ii) An agreement should be concluded between the Argos Operations Committee and the Brazilian Space Agency (INPE) to integrate the planned Brazilian 3-satellite system with Argos-type equipment into the Argos system, in view of the potential benefit of such integration to DBCP programmes;

The Operations Committee endorsed these actions as part of the Argos development programme.

C . Gal (Operations Committee Co-chairman made a brief presentation on on-going discussions with the Brazilian space agency INPE, regarding a possible cooperation between the Brazilian DCS and the Argos DCS.

The Argos Operations Committee, confirmed its interest in continuing these discussions.

The Operations committee proposes to take the opportunity of the next CEOS meeting to review the progress made in the discussions. In order to inform INPE of this proposal, the co-chairs will send a letter to his INPE Director, Mr. Barbosa.

(iii) The JTA should continue to emphasize cost control, increased system efficiency and greater usage of data collection and distribution systems within Argos, in view of the likelihood that there would be few new sources of funding for ocean observing networks in the forseeable future.

Item open.

5.3 The JTA supported these recommendations. CLS/Service Argos was requested to take the necessary actions in response to the needs identified, in conjunction with appropriate bodies.

Argos GTS sub-system developments (see the report of the DBCP Technical Coordinator)

The following developments have been conducted with regard to the GTS sub-system:

Small improvements

STD format:
BUOY code, housekeeping parameters:
BUOY code, location date:

Specific algorithm for TAO moorings

No decision has been made by PMEL in this regard yet so CLS did not evaluate required developments.

GTS distribution of sub-surface floats